Are changes in blood pressure and total cholesterol related to changes in mood? An 18-month study of men and women

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Running head: Mood and cardiovascular risk factors

Abstract

The authors investigated the within-person association of reported mood with blood pressure and total cholesterol (TC) levels, each assessed 4 times over an 18-month period in 128 men and 154 women. Change over time in level of tense arousal was significantly positively associated with changes over time in systolic blood pressure (SBP) and diastolic blood pressure (DBP), but not TC. A change in hedonic tone was significantly associated with a change in SBP (an increase in negative affect was associated with an increase in SBP), but not in DBP or TC. There were no sex differences in associations of mood with SBP or TC. However, increases in tense arousal and negative affect were significantly associated with an increase in DBP for women, but not men.

Key words: blood pressure, cholesterol, mood, stress, multilevel models, sex differences.

Many of the main psychosocial factors implicated in the pathogenesis of cardiovascular disease, such as social isolation, personality traits, job strain, clinical anxiety and depression (Hemingway and Marmot, 1999), are likely to act at least partly through their effects on affective state or mood (Feldman et al., 1999; Kubzansky and Kawachi, 2000). It has also been suggested that known links between socioeconomic status and ill-health, including cardiovascular disease, are mediated partly through negative emotions (Gallo and Matthews, 1999). While it may be that stressors exert additional direct physiological influences via mechanisms that do not involve conscious psychological processes, the role of conscious affective state has been accorded primacy in the literature. Mood is believed to have a direct effect on the sympathetic adrenal medullary and the hypothalamic pituitary adrenal cortical neuroendocrine axes, which influence both blood pressure and serum lipid levels (Henry, 1982; Gallo and Matthews, 1999).

Longitudinal repeated measures studies provide an attractive design for assessing links between mood and cardiovascular risk factors. Each individual acts as his or her own control, so that concerns about between-person differences in the reporting of affect are unnecessary. However, little attention has been given to directly testing whether changes, or within-person variation, in affective states predict changes in cardiovascular risk factors, partly because of the problems involved in analyzing time-varying within-person covariation using standard statistical techniques. Schwartz and Stone (1998) have shown that multilevel models provide a powerful new tool to handle such analyses and some recent studies have taken advantage of this analytical method. Most of this work has investigated links between changes in momentary affective state and ambulatory blood pressure during the course of a day or, at most, a few days. Such studies have shown that short-term changes in mood are associated with changes in blood pressure (Schwartz, Warren & Pickering, 1994; Kamarck et al., 1998; Jacob et al., 1999). Only a few studies have assessed whether longer-term changes in mood are also associated with changes in blood pressure or serum lipids. Brondolo, Rosen, Kostis & Schwartz (1999) found no association between changes in self-reported negative affect and changes in blood pressure in 54 mildly hypertensive men whose blood pressure was taken repeatedly over a period of several months. Using other statistical methods, McCann and colleagues found a significant positive association between changes in perceived stress and total cholesterol (TC) in a 4-month study of 14 men and women (McCann, Warnick & Knopp, 1990). However, in a subsequent, larger study of men and women (N=173) they found no association between changes in perceived stress and several different serum lipids or blood pressure when comparing assessments made at times of normal versus high workload during a 2-year period (McCann et al., 1999). Similarly, Niaura et al. (1991) reported no association between changes in perceived stress and serum lipid levels over several months in their three separate studies of 16-40 men and women. None of these studies controlled for the effect of changes in weight on blood pressure or serum lipids, despite the fact that weight is known to covary over time with blood pressure (Gerber et al., 1999) and serum lipids (Siervogel et al., 1998), and controlling for body mass index (BMI) is standard in cross-sectional studies. It is likely that controlling for BMI would reduce the error variance in these models, perhaps allowing a marginally significant effect of mood to be detected.

There has been some discussion about the relative effects of arousal versus negative affect on blood pressure (Jacob et al., 1999). Arousal and hedonic tone (the latter also known as valence, and referring to positive versus negative affect) are often considered independent dimensions of mood, which together can be used to define a wide variety of affective states (Russell, 1979). Kamarck et al. (1998) found that both negative affect (assessed by ratings of sad, frustrated, stressed and upset i.e. a mixture of high and low arousal negative affect terms) and neutrally connotated high arousal (alertness versus tiredness) were associated with elevated ambulatory blood pressure. Gellman et al. (1990), Schwartz et al. (1994), and Jacob et al. (1999) all found that ambulatory blood pressure was raised when arousal of either positive or negative valence was reported. Thus the evidence suggests that any kind of emotional arousal, but perhaps not change in affect not involving arousal, results in an increase in blood pressure. However, this issue is not yet resolved, and no such comparisons have been conducted for serum lipids.

There may be gender (socially constructed) or sex (biologically determined) differences in associations between arousal, hedonic tone, blood pressure and serum lipids. In particular, results of laboratory studies have often, but not always, shown smaller systolic blood pressure (SBP) responses to standard stressors in women than in men (Stoney, Davis & Matthews, 1987). Laboratory studies have also shown smaller SBP responses in premenopausal women or women taking hormone replacement therapy, compared to postmenopausal women not taking hormone replacement therapy (e.g. Saab, Matthews, Stoney & McDonald, 1989; del Rio et al., 1998). Differences in diastolic blood pressure (DBP) responses have been less frequently observed. These results have been interpreted as suggesting that estrogen may act to reduce systolic blood pressure responses to stressors in women compared to men (Stoney et al., 1987; Light, Girdler, West & Brownley, 1998; Pollard, 1999). However, it is also possible that women's affective responses to many of the standard laboratory stressors differ to those of men. Since sex differences in the direct effects of negative mood or arousal on blood pressure have not been assessed, these laboratory studies do not necessarily test whether equal changes in mood have the same consequences for blood pressure in men and women (Pollard, 2001b). Ecological studies that have investigated sex differences in associations between mood and ambulatory blood pressure have failed to find differences for either SBP or DBP (Schwartz et al., 1994; Kamarck et al., 1998). Less research has been conducted with respect to sex differences in serum lipid responses, but Stoney, Matthews, McDonald & Johnson (1988) and Niaura, Stoney & Herbert (1992) suggest that men may show bigger responses to stressors (again, affect *per se* has not been assessed) than women.

In this paper we use multilevel models to investigate the longitudinal (within-person) relationship of mood with blood pressure and TC, each assessed 4 times over an 18-month period in a sample of healthy local government employees. Two assessments took place before and two took place after a workplace reorganisation which affected all employees studied. The present analyses, focusing on within-person associations of mood with blood pressure and TC, do not rest on exposure to a common stressor, although it is clear that the stressor enhanced negative mood, with distress at its highest level at the second assessment, a time of considerable uncertainty about future employment prospects (Pollard, 2001a).

We measured both tense arousal and hedonic tone in order to test the hypothesis that only negatively connoted arousal (high scores on the tense arousal scale), and not negative valence *per se* (as assessed by the hedonic tone scale), is related to blood pressure and, since similar mechanisms are invoked, TC. As noted above, changes in BMI are known to predict changes in blood pressure and serum lipids and our analyses therefore controlled for BMI. The effect of season was also controlled in the analyses, since the importance of seasonal changes in blood pressure and TC in this data-set have previously been demonstrated (Pollard, 2001a). In addition we tested for any sex differences in the relationships of affect to blood pressure and cholesterol.

Methods

Participants

Volunteers were sought from employees of five local councils (providers of local government services) which were being obliged by legislative changes to undergo large-scale reorganisation. Together, the councils employed 25,000 full-time staff. Information about the study was distributed using posters and a staff newsletter, and volunteers not suffering from cardiovascular disease or diabetes were requested to return a reply slip to the researchers. In total 282 volunteers participated in the first assessment. At the second assessment 247 (88%) returned. Only these 247 were approached to attend the last two appointments and, of these, 223 (90%) completed the third assessment, including 16 people who had taken early retirement or who had accepted a remuneration package in return for leaving their jobs. At the final assessment 196 (85%) of the 231 still employed by the councils were reassessed and those who had left council employment were not approached. Three of those still in work were prescribed beta-blocker drugs between the second and third assessments, one for migraine headaches and two for high blood pressure, and their data from subsequent sessions are excluded from the analyses. Data were missing for the mood assessments on a total of 8 occasions, reducing the number of data points used for the analyses predicting blood pressure to 940. Data were missing for TC on

18 occasions, due to failure to obtain blood for assessment, so that 922 data points were used in the models predicting cholesterol.

Of the 282 participants, 128 (45 %) were men and 154 (55%) were women; 281 (99.6%) were of European origin. The age range was 25 to 59 at the first assessment and the mean age was 41.2 ± 8.3 years; 39 (25%) of the women reported being postmenopausal at this stage, of whom 23 were taking hormone replacement therapy. There were 57 (20%) smokers. The highest educational achievement reported was no formal examinations for 23 (8%) people, GCSEs (age 16 examinations) or equivalent for 86 (31%), A levels (age 18 examinations) or equivalent for 96 (34%), and a university degree for 77 (27%). Most participants (98%) were non-manual workers and most (93%) worked full-time. The relatively small group of volunteers who took part in the study was unlikely to be a representative sample of the employees of the councils and this is a limitation of the study. However, the aim of the study was to investigate associations between mood and physiological outcomes at the within-person level, and any biases in the sample were unlikely to be systematically related to individual differences in such associations. There were no significant differences between those who completed all 4 assessments (N=184) and those who failed to attend at least one assessment in age, sex, or initial levels of tense arousal, hedonic tone, BMI, SBP, DBP or TC.

Study design

The four assessments were timed as follows: August to September 1995, December 1995 to January 1996, August to September 1996 and December 1996 to January 1997. At each assessment participants were invited to an appointment at their workplace, during which they completed a questionnaire and were measured.

Measurements

Mood. Affective state during the week prior to the assessment was measured using the UWIST (University of Wales Institute of Science and Technology) mood adjective checklist, as validated by Matthews et al. (1990) for a British population. Participants were asked to describe their average feelings over the last week. Two scales were used; tense arousal is designed to assess the degree of negatively connoted arousal, while hedonic tone is a bipolar measure of affect, independent of the degree of arousal. They are not designed to be independent scales. Tense arousal was assessed by the following items: anxious, jittery, tense, nervous, calm, restful, relaxed and composed, with the last four reverse-scored. Hedonic tone was assessed by: cheerful, contented, satisfied, happy, dissatisfied, depressed, sad and sorry, with the last four reverse-scored. The response format was changed slightly to provide five options from 1 (not at all) to 5 (very). The sum of all eight items was used. Cronbach's alpha was .89 for tense arousal and .88 for hedonic tone at the first assessment, indicating good reliability.

Cardiovascular risk factors. Weight was measured without shoes and heavy clothing. Body mass index (BMI) was calculated as weight/(height^2), using self-reported height, which may slightly reduce the reliability of this measure. After sitting for at least two minutes, two blood pressure measurements were taken two minutes apart, from the left arm. An automated oscillometric meter (the UA-701, A&D Company Limited, Tokyo, Japan) was used and the average of the two measurements was calculated. TC level was measured using a compact analyser (the Accutrend GC, Boehringer Mannheim, UK), which requires one drop of blood, obtained by finger-prick. Measurements were taken throughout the day and are not fasting values. The Accutrend GC measures TC in capillary blood using reflectance photometry and has been shown to provide a valid, reliable and practical alternative to laboratory assessments of cholesterol requiring more invasive venipuncture (Warnick, 1994; Gottschling, Reuter, Ronquist, Steinmetz & Hattemer, 1995). Quality control checks were performed as recommended, at the beginning of each day. Participants whose values fell outside the range of the analyser (below 150 mg/dl (6.5% of all measurements) or above 300 mg/dl (2.4% of all measurements)) provided further drops of blood for analysis using a Home Cholesterol Test manufactured by Boots, UK. Both types of equipment only allow the testing of TC, which is a limitation of the study.

Statistics

Developments in multilevel mixed-model analyses since the early 1980s have made possible longitudinal within-person analyses evaluating associations between changes over time in independent variables (in this case mood) and changes over time in dependent variables (in this case blood pressure and cholesterol) (Schwartz and Stone, 1998; Brondolo et al., 1999). Heuristically, it is convenient to imagine a time series in which both mood and blood pressure have been assessed many times for a single individual. We could create a scatterplot with mood (e.g., tense arousal) on the horizontal axis and SBP on the vertical axis, ignoring the timing of the assessments, and fit a regression line to the points. If a positive association were evident, we would then conclude that higher levels of mood are associated with higher SBP for this person or, stated differently, changes in mood are positively associated with changes in SBP. With separate time series for each of many individuals, often with fewer assessments per individual, we are interested in the pooled (similar to average) within-person association of mood and SBP, but care must be taken to not confound this estimate with any between-person association of average mood with average SBP. In mixed models this is handled by correct specification of random effects and/or the error structure of the residuals for the model.

Mixed models also allow the simultaneous estimation of between-person effects, addressing average cross-sectional relations such as that of sex with blood pressure or cholesterol level. For this study, we initially estimated a baseline model for each outcome variable that included the person-level (between-person) characteristics of age and sex and the time-varying (within-person) covariates of BMI and season. Sex and season were coded as 0/1 dummy variables. For SBP, this equation was:

$$SBP_{it} = \alpha + \beta_1\ Age_i + \beta_2\ Sex_i + \gamma_1\ BMI_{it} + \gamma_2\ Season_{it} + \varepsilon_{it}$$

To test the hypothesis that changes in mood would be associated with changes in blood pressure (or cholesterol), we next added mood (either tense arousal or hedonic tone) to the equation.

$$SBP_{it} = \alpha + \beta_1\ Age_i + \beta_2\ Sex_i + \gamma_1\ BMI_{it} + \gamma_2\ Season_{it} + \gamma_3\ Mood_{it} + \varepsilon_{it}$$

Last, we tested whether the effect of mood differed for males and females by adding a multiplicative interaction term.

$$SBP_{it} = \alpha + \beta_1\ Age_i + \beta_2\ Sex_i + \gamma_1\ BMI_{it} + \gamma_2\ Season_{it} + \gamma_3\ Mood_{it} + \gamma_4\ Sex_i{*}Mood_{it} + \varepsilon_{it}$$

When an interaction term was significant, an alternative specification of the preceding model was used to obtain separate coefficients (and standard errors) for the association between mood and outcome for each sex.[1]

$$SBP_{it} = \alpha + \beta_1\ Age_i + \beta_2\ Sex_i + \gamma_1\ BMI_{it} + \gamma_2\ Season_{it} + \gamma_{4k}\ Sex_{i(k)}{*}Mood_{it} + \varepsilon_{it}$$

In each analysis, the ε_{it} are assumed to be normally distributed with a mean of zero (for t=1, 2, 3, or 4) and uncorrelated with any of the observed variables; however, the variances are permitted to vary across the four assessments and person i's residuals are allowed/assumed to be correlated across time with no constraints placed on these correlations; that is, $r(\varepsilon_{it}, \varepsilon_{it'})$ need not be constant for different combinations of t and t'. This assumption, the same as is typically used in MANOVA analyses of repeated measures data, subsumes a model in which the intercept, α, is assumed to vary from person to person and is treated as a random effect. In so doing, it also ensures that the coefficients of the time-varying covariates (the γ's) estimate "pure" within-person effects, unconfounded by between-person associations (e.g., average BMI across the four assessments is almost surely associated with blood pressure). As such, each γ is an estimate of the predicted change in SBP from one assessment to another associated with someone's BMI or mood increasing by 1 unit between these same two assessments. PROC Mixed, part of the SAS statistical package (Littell, Milliken, Stroup & Wolfinger, 1996), provides estimates and test statistics of between- and within-person effects for models/equations of this type. An advantage of this software is that it uses all of the available data; traditional repeated measures analysis of variance software typically excludes an entire subject's data if he/she failed to complete any of the assessments.

Results

Mean values of each variable at each assessment are given, separately for men and women, in Table 1. We expected that changes in tense arousal and hedonic tone would be correlated (Matthews et al., 1990). Their pooled within-person correlation was -0.73.

Estimates of the baseline models, showing the relationships of the covariates with blood pressure and TC are shown in Table 2. Age was significantly positively associated with SBP, DBP and TC. Women had significantly lower SBP and DBP than men, but there was no sex difference in TC. Change in BMI was significantly and positively associated with change in SBP, DBP and TC. All three outcomes were also significantly higher in the winter than in the summer.

The associations of tense arousal and hedonic tone with blood pressure and TC were tested separately in models that controlled for age, sex, BMI and season (Table 3). Change in tense arousal was significantly positively associated with changes in SBP and DBP, but not in TC. Change in hedonic tone was significantly inversely associated with change in SBP, but not DBP (marginally significant) or TC. To illustrate the scale of these associations, we note that since the within-person standard deviation of tense arousal is 6.87, someone whose tense arousal score increased from one standard deviation below her mean to one standard deviation above would be predicted to have her SBP increase by 1.5 mmHg (2*6.87*0.11) and her DBP increase by 1.1 mmHg (2*6.87*0.08).

For each of the three outcome measures, neither mood variable was statistically significant after controlling for the other. Thus, we are unable to conclude that either mood dimension is a significantly better predictor than the other of blood pressure or TC.

To test whether there were any sex differences in the associations of affective state with blood pressure and TC, the interaction between sex and affective state was added to the models shown in Table 3. For SBP and TC the interaction effects were non-significant ($p>.17$ in all cases). For DBP the interaction effect was significant for tense arousal ($t=2.10$, $p=0.04$) and approached significance for hedonic tone ($t=1.84$, $p=0.07$). There was a significant positive association between tense arousal and DBP for women (estimate=0.14, $t=3.04$, $p=.002$) but not for men (estimate=

-0.006, t=0.11, p=.91). Similarly, there was a significant inverse association between hedonic tone and DBP for women (estimate=-0.12, t=2.49, p=.01) but not for men (estimate=-.01, t=0.20, p=.84).

Discussion

Our results show that longitudinal changes in self-reported affective state were associated with changes in blood pressure, but not TC, over a period of 18 months. To our knowledge, this effect has not previously been reported for blood pressure over such an extended time scale. For example, McCann et al. (1999) observed no association between perceived stress and blood pressure using the same number of assessments as this study, over a similar time period, but it is possible that their use of a single item measure of affective state, and their analytical technique, which included averaging results over separate occasions, accounts for the differences in our findings. Both McCann et al.'s study and ours were limited by the use of casual readings of blood pressure at each assessment - one in their study, and the average of two in this study.

We asked participants to report their average feelings over the week prior to each assessment and thus suggest that, in addition to responding to momentary changes in mood as assessed by ambulatory studies, blood pressure at any one assessment reflects a more general level of affect. However, we cannot exclude the possibility that the observed associations reflect only the momentary effect of current mood on both reported mood for the previous week and blood pressure (Stone and Shiffman, 1992).

We found that tense arousal and hedonic tone had similar effects, with blood pressure elevated in association with both types of negative affect assessed by these scales. Thus the hypothesis that only tense arousal would affect either blood pressure or cholesterol was rejected. Our analyses did not indicate an independent effect of either mood scale - the significant association of each mood with SBP, when tested separately, is largely attributable to their shared variance. This result suggests either that negative affect, which was assessed by both scales, is the primary affective determinant of blood pressure variation or, more probably, that the high correlation between the moods in this study made statistical separation of their effects difficult.

The lack of association between change in mood and change in TC replicates the findings of two earlier studies (Niaura et al., 1991; McCann et al., 1999). Our use of non-fasting measures of total cholesterol only may have influenced our ability to detect effects on lipids. However, McCann et al's (1990) much smaller study is the only ecological study to have shown a relationship between change in affective state (perceived stress) and change in any serum lipid. Niaura et al. (1992) noted that where responses of separate subfractions of cholesterol to stressors have been observed they have changed in the same direction.

Change in BMI was strongly associated with changes in blood pressure (consistent with Gerber et al., 1999) and change in TC. We suggest that future studies investigating direct effects of mood on blood pressure and serum lipids should control for changes in BMI. The effect of season was also highly significant, with blood pressure and TC both higher during the mid-winter assessments than during the late-summer assessments. As McCann et al. (1999) have also noted, seasonal effects are potentially of great importance for studies involving assessments at different times of the calendar year and they should be considered in future studies.

We found no evidence of any sex difference in the relationship between mood and either SBP or TC. However, women showed a stronger relationship between mood and DBP than men. Other ecological studies of blood pressure and mood have reported no sex difference (Schwartz et al., 1994; Kamarck et al., 1998). Thus, it may be that the smaller blood pressure and lipid responses observed in women in response to stressors in experimental studies, where affective state has rarely been assessed, reflect different affective responses to the same laboratory stressors, perhaps because of differential engagement or effort (Pollard, 2001b). More work is required to clarify discrepancies between laboratory and ecological studies with respect to sex differences in cardiovascular responsivity, and research is also needed to identify other factors which may underlie individual differences in cardiovascular responses to mood (Matthews et al., 1992; Schwartz et al., 1994; Feldman et al., 1999).

Our results provide new evidence strengthening the suggestion that affective state is likely to have a role in mediating the effects of psychosocial experience on blood pressure, and thus perhaps on cardiovascular disease. We suggest that future studies of the effects of exposure to stressors should include assessments of the mediating role of mood, as recommended by Stoney et al. (1999), and also that more research is needed to clarify physiological responses to mood, particularly serum lipid responses. Future studies should make use of the relatively new, more versatile statistical procedures for multilevel modeling.

Footnote

[1] In SAS (version 8.1), the syntax for specifying the first interaction model is:

```
Proc mixed noclprint covtest dfbw;  Class subj_id time sex;
Model DV = age sex bmi season mood sex*mood / solution;
Repeated time / type=un sub=subj_id;
```

To obtain estimates of the effect of mood for males and females separately, delete the main effect of mood from the model statement (line 2):

```
Model DV = age sex bmi season sex*mood / solution;
```

Note: the inclusion of 'sex' in the Class statement is optional for the first specification, but required for the second.

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Table 1

Descriptive statistics for independent and dependent variables at each assessment, by sex, (mean ± SD, with sample sizes in parentheses).

	Summer '95	Winter '95/96	Summer '96	Winter '96/97
Tense arousal*				
Men	20.6 ± 6.3 (128)	23.1 ± 6.4 (119)	20.7 ± 6.6 (106)	20.5 ± 5.9 (93)
Women	21.9 ± 6.6 (154)	25.2 ± 6.5 (128)	22.3 ± 6.6 (110)	23.0 ± 6.0 (102)
Hedonic tone*				
Men	29.0 ±6.5 (128)	27.1 ± 6.3 (119)	29.3 ± 6.3 (106)	28.4 ± 5.8 (93)
Women	29.0 ± 6.1 (154)	26.4 ± 6.1 (128)	27.6 ± 6.1 (110)	27.6 ± 5.6 (102)
Body mass index				
Men	26.1 ± 3.3 (128)	26.2 ± 3.4 (119)	25.9 ± 3.4 (106)	26.4 ± 3.4 (93)
Women	25.4 ± 4.2 (154)	25.6 ± 4.3 (128)	25.5 ± 4.4 (110)	25.8 ± 4.6 (102)
SBP (mmHg)				
Men	122.0 ± 12.2 (128)	126.1 ± 13.9 (119)	124.0 ± 11.3 (106)	125.0 ± 13.7 (93)
Women	114.5 ± 15.1 (154)	118.9 ± 15.4 (128)	115.7 ± 12.8 (110)	117.4 ± 14.2 (102)
DBP (mmHg)				
Men	75.8 ± 9.2 (128)	76.7 ± 9.8 (119)	76.1 ± 8.4 (106)	77.0 ± 9.5 (93)
Women	71.3 ± 10.0 (154)	74.6 ± 10.3 (128)	72.4 ± 8.8 (110)	72.7 ± 9.0 (102)

Total cholesterol (mg/dl)				
Men	203.2 ± 42.2 (121)	216.3 ± 43.0 (117)	202.0 ± 40.0 (103)	213.8 ± 40.1 (90)
Women	199.2 ± 39.9 (153)	211.9 ± 42.1 (127)	202.8 ± 41.9 (109)	208.1 ± 40.6 (102)

* Tense arousal and hedonic tone scales have a possible range of 8-40.

Table 2

Baseline models predicting blood pressure and total cholesterol. Age and sex are between-person variables, BMI and season are within-person variables, varying over time. Observations used = 940 for SBP and DBP, 922 for cholesterol.

	SBP			DBP			TC		
	Estimate	t	P	Estimate	t	P	Estimate	t	p
Intercept	125.5	118.64	0.0001	77.1	107.0	0.0001	211.5	67.12	0.0001
Age	0.25	2.96	0.003	0.22	3.88	0.0001	1.62	6.32	0.0001
Sex[a]	-7.05	5.13	0.0001	-3.77	4.02	0.0001	-1.89	0.45	0.65
BMI	1.15	7.12	0.0001	0.72	6.59	0.0001	1.74	3.62	0.0004
Season[b]	-2.35	5.23	0.0001	-1.09	3.48	0.0006	-10.80	8.83	0.0001

[a] 0=Male, 1=Female

[b] 0=Winter, 1=Late summer

Table 3.

Results for separate models testing associations of tense arousal and hedonic tone with blood pressure and TC, controlling for age, sex, BMI and season. Observations used = 940 for SBP and DBP, 922 for cholesterol.

	SBP			DBP			TC		
	Estimate	T	P	Estimate	T	P	Estimate	T	p
Tense arousal	0.11	2.07	0.04	0.08	2.20	0.03	-.03	0.19	0.85
Hedonic tone	-0.11	2.04	0.04	-.06	1.68	0.09	-.11	0.80	0.42